GE Industrial Systems

Crowbar Circuit Gate Power Interface Board IS200FGPIG_A_ _

Safety Symbol Legend

Warning

Indicates a procedure or condition that, if not strictly observed, could result in personal injury or death.

Caution

Indicates a procedure or condition that, if not strictly observed, could result in damage to or destruction of equipment.

Note Indicates an essential or important procedure or statement.

These instructions do not purport to cover all details or variations in equipment, nor to provide every possible contingency to be met during installation, operation, and maintenance. If further information is desired, or if particular problems arise that are not covered sufficiently for the purchaser's purpose, the matter should be referred to GE Industrial Systems.

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Functional Description

The IS200FGPI Crowbar Circuit Gate Power Interface Board (FGPI) is a special purpose board used in the 3300 V and 6600 V Innovation Series™ Medium Voltage - SP Drives that serves as the interface between the Innovation Series control and the dc bus crowbar power circuit.

The FGPI board accepts a power input of 84 volts to 130 volts (120 volts nominal), 50/60 Hz from a standard control power transformer (CPT). The board generates the various voltages needed for its own operation from this input.

The board includes testpoints, test rings, and diagnostic LED indicators. It is located close to the power bridge and mounted on insulating standoffs. It is not conformal coated. The FGPI board interfaces with the IS200GGXD Expander Diode Source Board (GGXD), DS200FHVA High Voltage Gate Interface Board (FHVA), and IS200EXIC IGCT Exciter Control Interface Board (EXIC).

See Figure 1 for board block diagram and Figure 2 for interfaces.

Innovation Series is a trademark of General Electric Company, USA

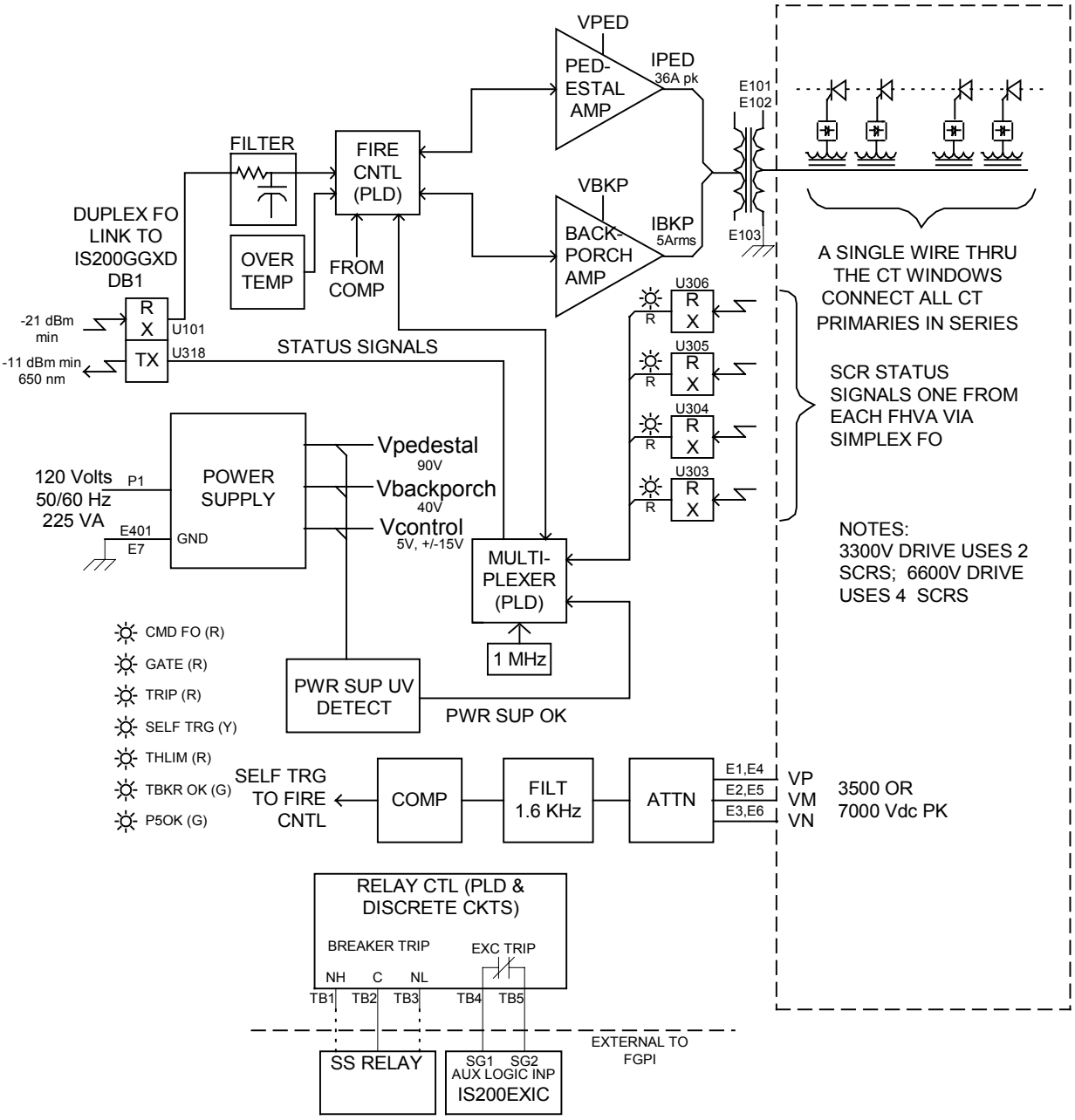


Figure 1. FGPI Board Operation Block Diagram

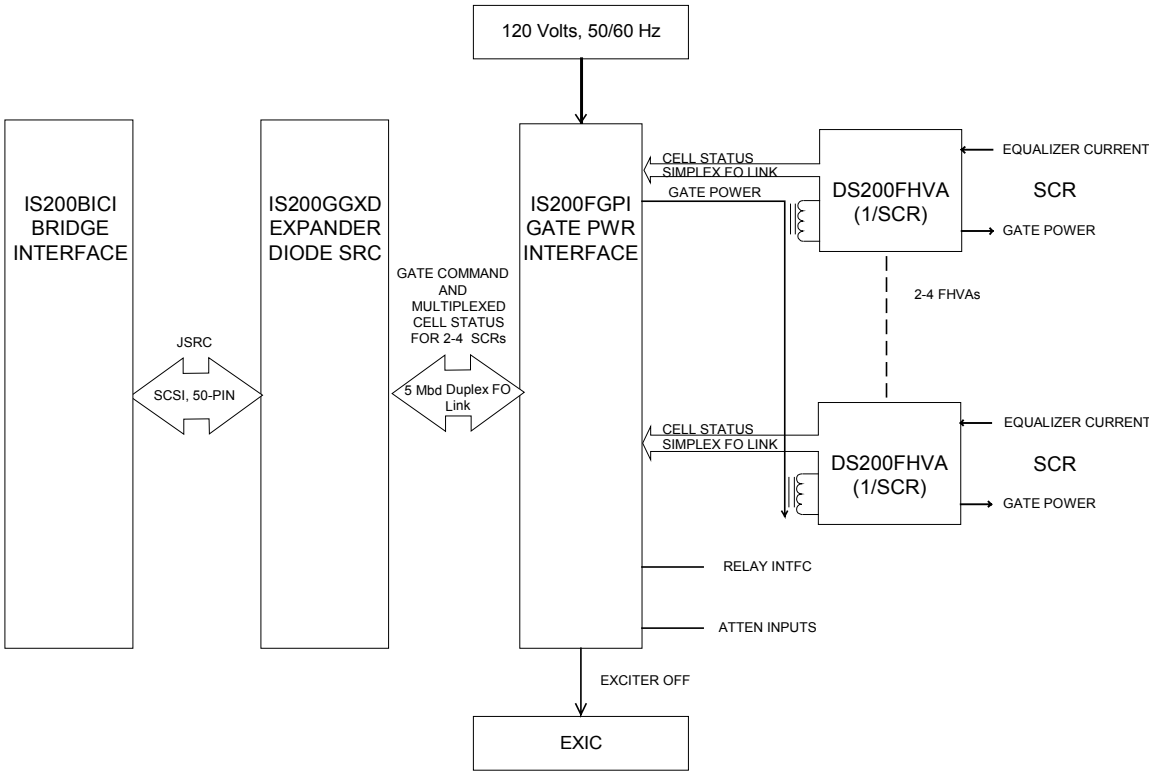


Figure 2. FGPI Board Interfaces

The main features/functions of the FGPI board are:

- Accepts gate commands (through plastic optical fiber - POF) from a GGXD board, produces suitable gate power for two (in 3300 V drives) or four (in 6600 V drives) SCRs that comprise the crowbar circuit, and produces a gate pulse for the FHVA gate interface boards to simultaneously fire all SCRs.
- Accepts cell status information (through POF) from two (in 3300 V drives) or four (in 6600 V drives) FHVA boards, combines these signals with other status information, and transmits the combined status through a single optical fiber to the control through the GGXD board. (The gate command and the status output form a duplex pair.)
- Provides a self-trigger function that fires the SCRs when the bus voltage reaches 1.3 Per Unit (PU) (+0/–.05 PU).
- Provides three discrete outputs for control of the main breaker and the exciter. These discrete outputs activate during normal firing and backup firing. A normally open relay contact is provided that is closed by the control to run the exciter. Normally high and normally low discrete outputs are provided to trip the main breaker through an external solid state relay.

Gate Power

The FGPI board provides gate power for two or four SCRs and two or four status feedbacks. The self-triggering circuit senses the bus voltage using two onboard attenuator strings. Gate command and status feedback comes from the GGXD board through a duplex fiber-optic link (POF). (See Figure 2.)

The gate current is a rectified ac waveform. Gate power from the FHVA is defined in two stages, *pedestal* and *backporch*.

- An initial application of power referred to as the *pedestal* (as seen by the gate terminals on the FHVA board).
- A second application of power is referred to as the *backporch*. It begins after termination of the *pedestal* and continues for two seconds.

Cell Status

The FHVA board contains a circuit that detects the presence of voltage across the SCR it is connected to. A signal signifying the presence of this voltage is generated and sent through simplex POF to the FGPI board (Light = cell voltage detected). The FGPI board receives the cell status signals from two or four SCRs. The status signals are multiplexed and transmitted through a single simplex POF to the GGXD board (see Figure 1).

Status Feedback

The following status feedbacks are serially transmitted through POF to the GGXD board:

- Board ID
- Power Supply OK (2)
- Cell Conduction Status (4)
- Gate Status
- Self-trigger
- Thermal Limit

Trip Relay and Exciter Enable Outputs

The trip relay output provides 24 V dc to activate the trip relay, with both active high and active low signals. This output is active whenever the FGPI board is commanded to fire, in both the command and self-trigger modes. The FGPI board limits these outputs to 40 mA. The power supply OK bit will be false if these outputs are shorted.

The exciter enable output is a set of contacts held normally closed by the programmable logic device (PLD). The contacts open whenever the FGPI board is triggered by the fiber-optic input, whenever it self-triggers, if the PLD malfunctions, or if input power is lost. This output connects to the EXIC board's auxiliary logic input (SG1, SG2). The open circuit voltage and short circuit current of the auxiliary logic inputs are 120 V ac and 8 mA respectively.

Normal Firing

During a thermal limit condition, the gate power, the 1GATE status bit, and the gating LED are inactive.

Light transmitted by the control initiates gate firing. The light power required to activate the fiber optic receiver is –21 dBm. The command is filtered using a time constant and a single-shot firing for two seconds initiates during which the following occurs:

- Gate Power ON
- 1GATE Status Bit High
- Gating LED ON
- Breaker Trip Active
- Exciter Contacts Open

Retriggering of the FGPI board is locked out for the duration of the single-shot event.

Bus Voltage Sensing and Self-trigger Function

The FGPI board senses the bus voltage directly using two attenuator strings. Attenuator taps are provided for both the 3300 V and 6600 V drives. The positive, negative and midpoint bus voltages are sensed.

Note A method for using the FGPI board in a 4160V Innovation Series Medium Voltage - GP Type G drive is provided by a different group number of the board.

During a thermal limit condition, the gate power, the 1GATE status bit, and the gating LED are inactive.

The FGPI board provides a self-trigger method that fires the crowbar SCRs when the bus voltage reaches 1.3 PU (+0/-.05 PU). The command to self-trigger is filtered using a time constant and a single-shot firing for two seconds initiates during which the following occurs:

- Gate Power ON
- 1GATE Status Bit High
- Gating LED ON
- Self-trigger Status Bit High
- Self-trigger LED ON
- Breaker Trip Active
- Exciter Contact Open

The following items will remain latched until control power is cycled:

- Self-trigger Status Bit High
- Self-trigger LED ON

Thermal Protection

The FGPI board goes into thermal limit after approximately 6 minutes of continuous operation. The gate current ceases when the thermal limit is reached (an onboard temperature sensor is used) and the gating LED and status bit are inactive. The thermal limit status bit will be high and the thermal limit LED will be ON.

The exciter contact, breaker trip output, self-trigger status bit, and self-trigger LED will behave normally. When the temperature has dropped through a defined band, the FGPI board will behave normally again.

Application Data

The JTAG plug connector on the FGPI board is for development use only and not described in this document.

The FGPI board includes five screw terminal connectors, eleven stab-on connectors, two plug connectors, six fiber-optic connectors, thirty-four user testpoints, three test rings, and eleven LED indicators. One potentiometer is provided to adjust the P5 voltage. This potentiometer is set at the factory and should not require further adjustment. Refer to Figure 3 for component locations and the following tables for descriptions.

Table	Description
1	P1 Plug Connector
2	Screw Terminal Connectors
3	Fiber-optic Connectors (for POF)
4	Stab-on Connectors
5	LED Indicators
6	Testpoints and Test Rings

Table 1. P1 Plug Connector, Power Input from CPT

Pin No.	Description
1	120 V, 50/60 Hz ac (nominal) AC1 power input
2	120 V, 50/60 Hz ac (nominal) AC1 power input
3	120 V, 50/60 Hz ac (nominal) AC2 power input
4	120 V, 50/60 Hz ac (nominal) AC2 power input

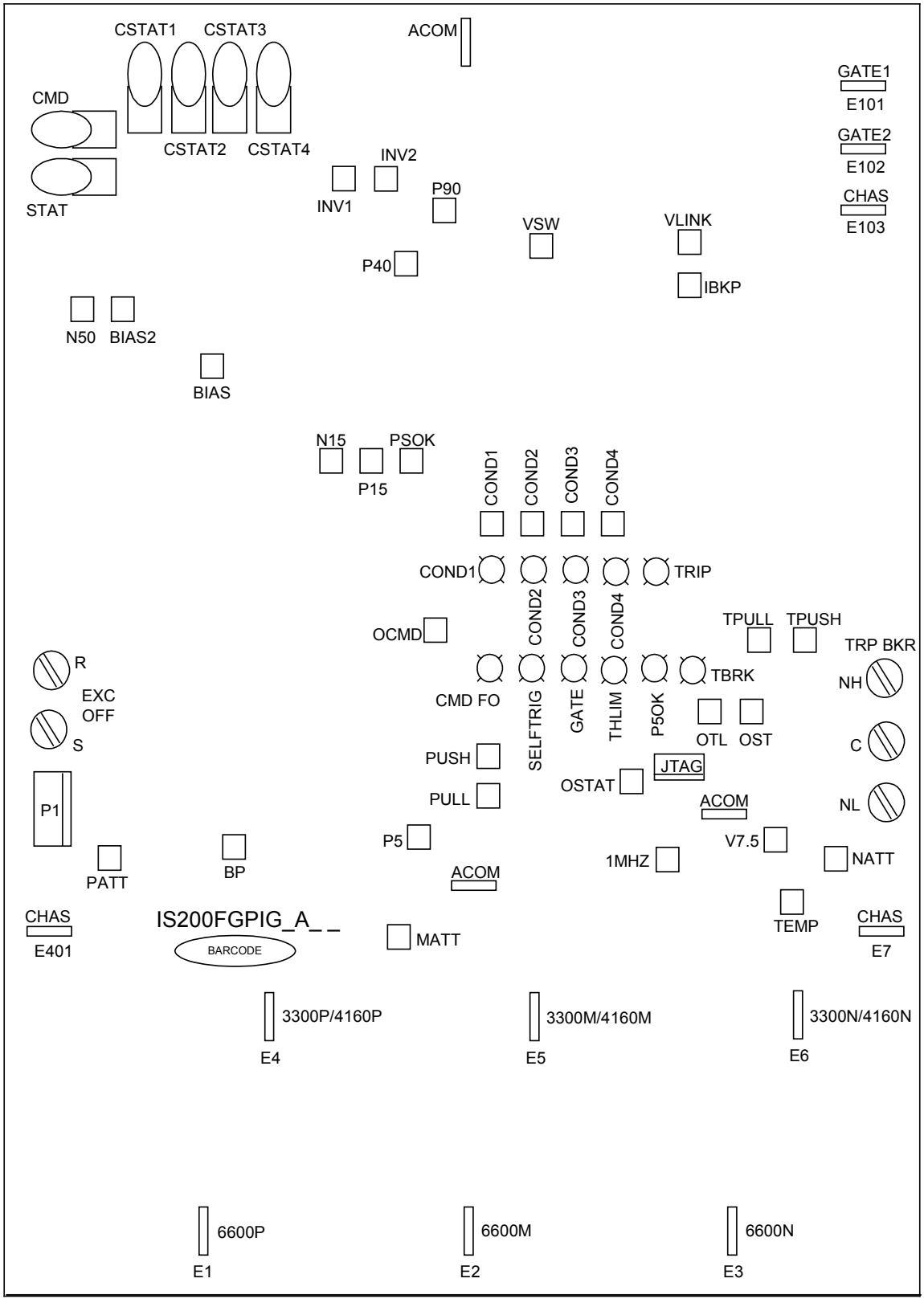


Figure 3. FGPI Board Layout Diagram

Table 2. Screw Terminal Connectors, Outputs to Breaker Trip Relay and EXIC Board

Terminal	Nomenclature	Description
TB1	NH (TRP BKR)	24 V dc active trip relay output to solid state breaker trip relay
TB2	C (TRP BKR)	24 V dc active trip relay output to solid state breaker trip relay
TB3	NL (TRP BKR)	24 V dc active trip relay output to solid state breaker trip relay
TB4	S (EXC OFF)	Normally closed relay contact output to EXIC board (open to turn exciter OFF)
TB5	R (EXC OFF)	Normally closed relay contact output to EXIC board (open to turn exciter OFF)

Table 3. Fiber-optic Connectors, Cell Status Inputs from FHVA Boards and GGXD Board Interface

Connector	Nomenclature	Description
U303	CSTAT4	Cell status input from FHVA board 4 (simplex POF)
U304	CSTAT3	Cell status input from FHVA board 3 (simplex POF)
U305	CSTAT2	Cell status input from FHVA board 2 (simplex POF)
U306	CSTAT1	Cell status input from FHVA board 1 (simplex POF)
U101	CMD	Gate command input from GGXD board (1/2 duplex POF)
U318	STAT	Multiplex status output to GGXD board (1/2 duplex POF)

Table 4. Stab-on Connectors, Dc Bus Inputs and Gate Power Outputs

Connector	Nomenclature	Description
E1	6600P	6600 V drive dc bus positive input for self-trigger function
E2	6600M	6600 V drive dc bus mid-point input for self-trigger function
E3	6600N	6600 V drive dc bus negative input for self-trigger function
E4	3300P/4160P	3300/4160 V drive dc bus positive input for self-trigger function
E5	3300M/4160M	3300/4160 V drive dc bus mid-point input for self-trigger function
E6	3300N/4160N	3300/4160 V drive dc bus negative input for self-trigger function
E7	CHAS	Chassis ground
E401	CHAS	Chassis ground
E101	GATE1	Gate power 1 output to four FHVA boards (return)
E102	GATE2	Gate power 2 output to four FHVA boards
E103	CHAS	Gate power ground to panel chassis

Table 5. LED Indicator Descriptions

LED	Color	Nomenclature	Description
DS1	Red	GATE	Gating current is being supplied to the SCRs
DS2	Yellow	SELFTRIG	Board has self-triggered and gated the SCRs. This indicator is latched ON until power is cycled
DS3	Green	TBRK_OK	Trip breaker output is not shorted
DS4	Red	THLIM	Board hotspot exceeded 80 °C and is still greater than 69 °C
DS5	Red	TRIP	Trip breaker output and exciter OFF relay are activated
DS101	Red	CMD FO	Fiber-optic command received
DS303	Red	COND4	Cell Status Feedback - SCR 4 is blocking voltage
DS304	Red	COND3	Cell Status Feedback - SCR 3 is blocking voltage
DS305	Red	COND2	Cell Status Feedback - SCR 2 is blocking voltage
DS306	Red	COND1	Cell Status Feedback - SCR 1 is blocking voltage
DS401	Green	P5OK	5 V power supply is healthy

Table 6. User Testpoints and Test Rings

Testpoint	Nomenclature	Description
TP1	TPUSH	Q102 drain, drives transformer that supplies gate power
TP2	TPULL	Q103 drain, drives transformer that supplies gate power
TP3	OCMD	Turn-on command from fiber-optic receiver, low active TTL
TP4	OSTAT	Status signal to fiber-optic transmitter, low active TTL
TP5	TEMP	Voltage corresponding to board temperature (hot spot)
TP6	PATT	Attenuated signal from positive high voltage attenuator
TP7	NATT	Attenuated signal from negative high voltage attenuator
TP8	OST	Self-trigger activated, low active TTL
TP9	BIAS	Bias current for power supply oscillator startup
TP10	BP	Rectified ac input power, positive
TP11	N50	Regulated voltage 50 V dc below BP for use in power supply
TP12	BIAS2	Regulated voltage 12 V dc above N50 for power supply control
TP13	INV1	Q403 drain, drives power supply transformer
TP14	INV2	Q404 drain, drives power supply transformer
TP15	ACOM	Analog common (test ring)
TP16	ACOM	Analog common (test ring)
TP17	ACOM	Analog common (test ring)
TP18	P15	Positive 15 V dc
TP19	N15	Negative 15 V dc

Table 6. User Testpoints — continued

Testpoint	Nomenclature	Description
TP20	V7.5	7.5 V dc reference for self-trigger comparator circuits
TP21	MATT	Attenuated signal from mid-point high voltage attenuator
TP22	OTL	Temperature limit exceeded, low active TTL
TP23	PSOK	P5, P40 and P90 power supplies OK, high active TTL
TP101	PULL	Turns on Q103, high active TTL
TP102	PUSH	Turns on Q102, high Active TTL
TP103	VSW	Output of buck switch in backporch supply
TP104	IBKP	Backporch output voltage
TP105	VLINK	Backporch or pedestal voltage
TP303	COND4	Cell #4 is conducting, active high TTL
TP304	COND3	Cell #3 is conducting, active high TTL
TP305	COND2	Cell #2 is conducting, active high TTL
TP306	COND1	Cell #1 is conducting, active high TTL
TP313	1MHZ	1MHZ oscillator output for PLD, TTL
TP401	P5	Positive 5 V dc
TP405	P90	Positive 90 V dc
TP406	P40	Positive 40 V dc

Renewal/Warranty Replacement

How to Order a Board

When ordering a replacement board for a GE drive, you need to know:

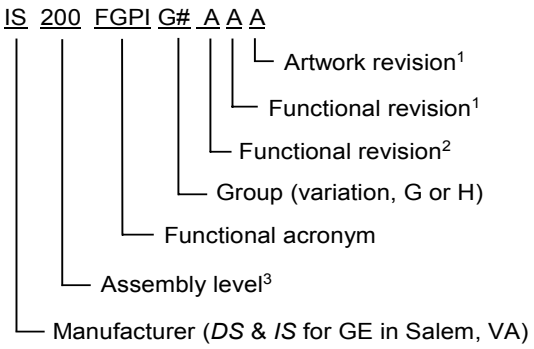
- How to accurately identify the part
- If the part is under warranty
- How to place the order

This information helps ensure that GE can process the order accurately and as soon as possible.

Board Identification

A printed wiring board is identified by an alphanumeric **part (catalog) number** located near its edge. Figure 4 explains the structure of the part number.

The board's functional acronym, shown in Figure 4, is normally based on the **board description**, or name. For example, the FGPI board is described as the Crowbar Circuit Gate Power Interface board.



[1]Backward compatible
[2]Not backward compatible
[3]*200* indicates a base-level board; *215* indicates a higher-level assembly or added components (such as PROM)

Figure 4. Board Part Number Conventions

Warranty Terms

The GE *Terms and Conditions* brochure details product warranty information, including **warranty period** and **parts and service coverage**. The brochure is included with customer documentation. It may be obtained separately from the nearest GE Sales Office or authorized GE Sales Representative.

Placing the Order

Parts still under **warranty** may be obtained directly from the factory:

("+" indicates the international access code required when calling from outside of the USA.)

GE Industrial Systems
Product Service Engineering
1501 Roanoke Blvd.
Salem, VA 24153-6492 USA

Phone: + 1 800 533 5885 (United States, Canada, Mexico)
+ 1 540 378 3280 (International)

Fax: + 1 540 387 8606 (All)

Renewals (spares or those not under warranty) should be ordered by contacting the nearest GE Sales or Service Office.

Be sure to **include the following** when ordering any warranty or renewal parts:

- Complete part number and description
- Drive serial number
- Drive Material List (ML) number

Note All digits are important when ordering or replacing any board. The factory may substitute later versions of replacement boards based on availability and design enhancements. However, GE Industrial Systems ensures backward compatibility of replacement boards.

Handling Precautions

Caution

To prevent component damage caused by static electricity, treat all boards with static sensitive handling techniques. Wear a wrist grounding strap when handling boards or components, but only after boards or components have been removed from potentially energized equipment and are at a normally grounded workstation.

Printed wiring boards may contain static-sensitive components. Therefore, GE ships all replacement boards in antistatic bags.

Use the following guidelines when handling boards:

- Store boards in antistatic bags or boxes.
- Use a grounding strap when handling boards or board components (per previous *Caution* criteria).

Replacement Procedures

Warning

To prevent electric shock, turn off power to the drive, then test to verify that no power exists in the board before touching it or any connected circuits.

Caution

To prevent equipment damage, do not remove, insert, or adjust board connections while power is applied to the equipment.

➢ To replace the FGPI board

1. Make sure that the drive in which the board resides has been de-energized. (Refer to the appropriate *User's Manual, GEH-6419,* for complete de-energizing procedures and follow all local practices of lock-out/tag-out.)
2. Open the rear bridge control cabinet door, and using equipment designed for high voltages, test any electrical circuits **before touching them** to ensure that power is off.
3. Locate the FGPI board and carefully disconnect all cables from the board as follows:
   - Verify all cables are labeled with the correct connector name (as marked on the board) to simplify reconnection.
   - Grasp each side of a stab-on connector that joins with the board's stab terminal and gently pull the stab-on connector loose.
   - For cables with pull-tabs, carefully pull the tab.
   - For screw terminal connections, loosen the screw and remove the wire connector from the terminal.
   - For fiber-optic cables, depress the latch on the mating connector and remove the fiber-optic cable.

Avoid dropping any mounting hardware into the equipment as this could cause damage when power is reapplied.

4. Remove the nine screws that hold the FGPI board to the insulating standoffs, and remove the board.
5. Orient the new FGPI board in the same position as the one removed and install it into the standoffs with the nine screws removed in step 4.
6. Reconnect all cables to FGPI board as labeled and ensure that cables are properly seated at both ends.
7. Close the bridge control cabinet door.

Notes

GE Industrial Systems

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